Significant Figures (sig figs) and Scientific Notation Reference Sheet

Significant figures are those digits in a measured number (or result of a calculation with measured numbers) that include all certain digits including a final one having some uncertainty.

9.12 cm – three sig figures: the uncertainty of this number is + or - .01
9.123 cm – four sig figures: the uncertainty of this number is + or - .001
9123 cm – four sig figures; the uncertainty of this number is + or - 1

All digits are significant except for zeros at the beginning of the number and possible terminal zeros.

9.12	3 sig figs
0.912	3 sig figs
0.000912	3 sig figs

Terminal zeros ending at the right of the decimal point are significant.

9.00 cm	3 sig figs
9.10 cm	3 sig figs
90.0 cm	3 sig figs
.000900 cm	3 sig figs

Terminal zeros without a decimal may not be significant, so therefore are not counted as significant.

900 cm (there is only one significant figure, 9. This number is certain to + or – 100)
900. cm (zeros are significant; there are 3 significant figures in 900. 900. is certain to + or – 1)

Significant figures only apply to calculations in which there are uncertainties, not when the number is exact. Numbers that are exact are counted objects (23 desks) and conversion factors
(1 ft = 12 inches)

Multiplication and Division

Give the same number of significant figures in the answer as the fewest number of significant figures of the numbers used.

Example:
3.0 meters x 621.1 meters. The calculator answer is 1,863.3 meter^2. Report the answer to two significant figures because 3.0 has two significant figures. The reported answer is 1900 meter^2.

Addition and Subtraction

Give the same number of decimal places in the answer as there are in the measurement with the least number of decimal places.

Examples

0.0634 has four decimal places
184.2 has one decimal place
2.325 has three decimal places
23 has no decimal places

Example:

0.0634 mg (4 decimal places)
+ 184.2 mg (1 decimal place)
184.2634 mg

Reported answer: 184.3 mg

Rounding; the procedure of dropping non-significant digits in a calculation and adjusting the last digit reported. When rounding digits after a decimal, lop off extra digits. When rounding before a decimal, change the remaining digits before implied decimal to 0.

5 or greater, round up by one
1.2151 rounded to three sig figures would be 1.22
456.1 rounded to two sig figures would be 460

4 or lower, stay the same
1.2143 rounded to three sig figures would be 1.21

Why? There are 5 digits between 0 and 4 (0, 1, 2, 3, 4,) and 5 digits between 5 and 9 (5, 6, 7, 8, 9). Rounding distribution is even.

Scientific Notation – represents the significant figures in a measurement in a concise way (also represents very large and small numbers in a concise way)

900. cm to two sig figures = 9.0×10^2 cm
900. cm to three sig figures = 9.00×10^2 cm

The coefficient is usually expressed a whole number followed by a decimal and any number of decimal places. This is called *standard scientific notation*.

Example:

3.42×10^{11}

3.42 is considered the coefficient.
10 is the base
^{11} is the exponent

Standard Form
6.23×10^{23}

Coefficient should be expressed with one digit between 1-9, followed by a decimal and additional significant figures. If answer isn't in standard form, decimal should be moved.

Moving the decimal

If a computation turns out to be 62.3×10^{22}, move the decimal one place to the left. (6.23×10^{23})

Effect on exponent
Moving a decimal to the left increases the exponent (think number line)
Moving a decimal to the right decreases the exponent (think number line)

Examples:

$.8943 \times 10^{-8}$
should be 8.943×10^{-9}

23.42×10^{11}
should be 2.342×10^{12}

Any number can be represented by scientific notation
$4 = 4 \times 10^{0}$

6329000 Implied decimal is after the last zero
6.329×10^{6} Same number represented by scientific notation
When the exponent is positive, the number is large (greater than one)
When the exponent is negative, the number if small (less than one)

Scientific Notation written in its Decimal Equivalent

4.21×10^{-6} Expressed in scientific notation
.00000421 Number of decimal equivalent
When expanding a negative exponent, move the decimal to the left

9.51×10^{4} Expressed in scientific notation
95100 Number when it is expanded
When expanding a positive exponent, move the decimal to the right

Exponents
$\frac{6.81 \times 10^{27}}{6.02 \times 10^{23}} = 1.13 \times 10^{4}$ First, divide the coefficient. Subtract the exponents.

$(2.01 \times 10^{14}) \times (2.68 \times 10^{3}) = 5.39 \times 10^{17}$ When multiplying exponents, add them